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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|---------------------|------------------|
| 10/600,345 | 06/23/2003 | Edward J. Anthony | 1004P60US01 | 7208 |
| 20779 | 7590 | 07/16/2004 | EXAMINER | |
| SHAPIRO COHEN P.O. BOX 3440 STATION D OTTAWA, ON K1P6P1 CANADA | | | HERTZOG, ARDITH E | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 1754 | |

DATE MAILED: 07/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|-------------------------------|--------------------------------|--|
| Office Action Summary | Application No. 10/600,345 | Applicant(s) ANTHONY ET AL. | |
| | Examiner Ardith E. Hertzog | Art Unit 1754 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 October 2003.
 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) 1-8 is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
 5) ☐ Claim(s) _____ is/are allowed.
 6) ☒ Claim(s) 1-8 is/are rejected.
 7) ☐ Claim(s) _____ is/are objected to.
 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
 10) ☒ The drawing(s) filed on 23 June 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input checked="" type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>21 October 2003</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Information Disclosure Statement

1. Receipt is hereby acknowledged of the information disclosure statement, filed October 21, 2003. As the submission is in compliance with the provisions of 37 CFR § 1.97, the information disclosure statement has been considered, in accordance with the enclosed PTO-1449.

Drawings

2. The drawings are objected to, as failing to comply with 37 CFR § 1.84 (p)(4), because: **1)** reference character "11" has been used to designate "a tubular electric furnace 11"; "the midportion 11 of a quartz tube 13"; **and** "the quartz tube 11" (see p. 7, paragraph [00028]); **and 2)** reference character "15" has been used to designate "line 15" (see p. 7, paragraph [00028]) **and**, apparently, the "Evaporator" (see Fig. 1).

3. The drawings are objected to, as failing to comply with 37 CFR § 1.84(p)(5), because: **1)** they do not include the following reference character mentioned in the description: "Line 17" (see p. 7, paragraph [00028]); **and 2)** they include the following reference character not mentioned in the description "12" (see Fig. 1).

4. The drawings are **also** objected to, in accordance with the enclosed PTO-948.

5. **Corrected drawing sheets, with amendment to the specification if/as necessary, are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended”. If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled “Replacement Sheet” in the page header (as per 37 CFR § 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. Any objection to the drawings will not be held in abeyance.**

Minor Informalities

6. The disclosure is objected to, because of the following minor informalities:
- a. In the abstract, it is suggested that “IGCC” be replaced with “integrated gasification combined cycle (IGCC)”, for clarity.
 - b. On page 3, in paragraph [0008], in line 11, “Wheelock in US

5,228,399" should perhaps (?) be "Wheelock in US 5,433,939", cited on the enclosed PTO-892 (since US 5,228,399 is actually to Weathery, cited on the enclosed PTO-1449).

c. On page 4, in reaction (3), " XaCO_3 " should apparently be " CaCO_3 ".

d. On page 6, in paragraph [00026], in line 1, "or" should apparently be "for".

e. On page 8, in paragraph [00031], in line 1, "a" should apparently be deleted.

f. On page 9, in lines 5 and 6, "about" is misspelled.

g. On page 10, in paragraph [00037], in line 2, "i" should apparently be "in", and, in line 3, "note" should apparently be "noted".

h. In claim 3, it is suggested that "furnace" be replaced with "fossil" for consistency with claim 2 (upon which claim 3 now depends) (alternatively, claim 3 could simply be changed to depend upon claim 1).

i. In claim 5, "chosen" should be replaced with "selected" for proper Markush group language (see MPEP § 2173.05(h) I.).

j. In claim 7, line 3, it is suggested that "or" be replaced with "and/or" for consistency with claim 1 (as well as paragraph [00019] on p. 6).

k. In claim 8, lines 1-2, it is suggested that "of Claim 1" be deleted, since "Claim 1" is already recited in the claim 8 preamble.

Appropriate correction of all the above is required.

Claim Rejections - 35 U.S.C. § 103

7. The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to

be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1-7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over the instant specification, pages 2 - 3, paragraphs [0005] - [0008], in view of the Qiu, Anthony, and Jia article cited on the enclosed PTO-892 (hereinafter "Qiu et al. 2001"). At instant page 2, paragraphs [0005] - [0008], applicant states:

IGCC systems involve a coal gasification step which is carried out in a gasifier under reducing conditions. Due to the different chemical conditions involved in the gasifier, instead of producing sulphur oxides in the hot gas, the sulphur is present chiefly as hydrogen sulphide, H₂S. The hydrogen sulphide must be largely removed, first due to the limit on the amount of sulphur that can be accepted in the gasses going forward to the turbine stage, and second due to the toxicity of hydrogen sulphide.

The step normally taken to capture the hydrogen sulphide is to react it with a calcium compound, by adding typically calcium oxide (lime) or limestone to the IGCC reactor. In the reactor, the powdered limestone reacts to produce mainly calcium sulphide, according to essentially the following reactions which occur more or less simultaneously:



This ash product cannot be sent to a landfill site, because reaction of ground water with the calcium sulphide produces poisonous hydrogen sulphide. At a practical level, almost quantitative destruction of the calcium sulphide is required before the ashes can be disposed of safely in a landfill site.

To destroy the calcium sulphide and to enhance process efficiency, it has been proposed to burn the ash product remaining from the coal gasification process, which will include calcium sulphide, calcium oxide, ash materials (from the coal or other carbonaceous feed material), and

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unburnt char, with air in a so-called topping cycle combustor, which is typically a pressurised fluidized bed combustor (hereafter PFBC) or preferably a circulating fluidized bed combustor (hereafter CFBC). (emphasis added)

Accordingly, based upon applicant's admitted prior art as cited above (per

MPEP § 2129¹):

A process for removing sulphide compounds from an exhaust gas flow from a first gasifier furnace in which a carbon containing fuel is consumed under reducing conditions, which process comprises:
... [as a first step,] providing in the furnace fuel an amount of limestone or calcium oxide sufficient to trap the sulphide compounds in the gas flow as calcium sulphide;
... [as a second step,] recovering the calcium sulphide as part of a first ash product from the furnace;
... [and, as a third step,] reacting the first ash product in a second furnace ... (instant claim 1, steps (a), (b), and the initial part of step (c))

was, again, known in the prior art at the time of applicant's invention. Note that the above cited admission by applicant **also** discloses "the IGCC reactor" as "first gasifier furnace" and "pressurised fluidized bed combustor (hereafter PFBC) or... circulating fluidized bed combustor (hereafter CFBC)" as "second furnace", as recited in instant claims 4 and 5, **as well as** the specific "furnace fuel" within the scope of both instant claims 2 and 3 (i.e., coal). **However**, the remaining part of step (c), as recited in instant claim 1, i.e.,

reacting the first ash product in a second furnace **with sufficient carbon dioxide at a partial pressure and at a temperature sufficient to convert the calcium sulphide in the ash product to calcium carbonate and/or calcium oxide and to provide a gas flow containing sulphur dioxide; (emphasis added)**

¹ "When applicant states that something is prior art, it is taken as being available as prior art against the claims. Admitted prior art can be used in obviousness rejections. *In re Nomiya*, 509 F.2d 566, 184 USPQ 607, 611 (CCPA 1975)" (see MPEP § 2129)

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is **not** acknowledged by applicant as admitted prior art; **analogously**, neither are the limitations of instant claims 6 and 7 (which refer back to this part of step (c), as recited in instant claim 1) acknowledged by applicant as admitted prior art.

9. Qiu et al. 2001 discuss oxidation of sulfided limestone under the conditions of pressurized fluidized bed combustion (PFBC), wherein:

Experiments were conducted ensuring that the partial pressure of CO₂ in the reaction gas mixtures exceeded the equilibrium pressure for CaCO₃ calcination. The effects of total pressure, O₂ partial pressure and temperature were examined to determine their influence on the conversion of CaS to CaSO₄ and **on the amount of CaCO₃ formed during the oxidation process.** The total pressure was shown to have only a relatively weak influence on the degree of conversion to sulfate, in spite of the fact that the conversion of CaS to CaSO₄ increased to a certain extent with increasing pressure at a constant oxygen volume fraction. However, **over the 0.1–2.0 MPa range, temperature had a strong influence on the CaS oxidation, its effect being more pronounced at lower pressures.** Furthermore, **the reaction of CaS with CO₂ occurred above 550°C and the solid product was primarily CaCO₃.** (abstract, emphasis added)

Qiu et al. 2001 **further** teach that “[u]nder these conditions, the formation of SO₂ can be expected to occur” (see paragraph bridging cols. 1-2 on p. 550). **Thus**, it would have been obvious to one of ordinary skill in the art, at the time of applicant’s invention, to have “burn[t] the ash product remaining from the coal gasification process, which will include calcium sulphide, calcium oxide, ash materials (from the coal or other carbonaceous feed material), and unburnt char,... in a... PFBC” (again, steps acknowledged by applicant as admitted prior art) with carbon dioxide, **rather than** air, **and** to have subsequently recovered the resultant sulphur dioxide, because, as just discussed, Qiu et al. 2001 **clearly** teach such use of carbon dioxide, **as well as** the resultant formation of sulphur

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dioxide, **concluding that:**

the reaction of CaS with CO₂ takes place at temperatures above 550°C and the solid reaction product is mainly CaCO₃, despite the fact that a small amount of CaSO₄ is found. The reaction between CaS and CO₂ indicates that CO₂ can play a significant role in CaS oxidation under PFBC conditions, due to the high CO₂ partial pressure in PFBC" (see last paragraph of "Conclusions" section on p. 557).

When having done so, it is respectfully submitted that, absent evidence otherwise, processes falling within the scope of instant claims 1-7 would have obviously resulted; note that the above cited teachings of Qiu et al. 2001 disclose temperatures which **overlap** the corresponding range recited in instant claim 6 (i.e., "above 550°C" overlapping "about 850°C to about 980°C"), **as well as** the calcium carbonate limitations of instant claim 7 (i.e., "the solid reaction product is mainly CaCO₃" reading on "at least 90% of the calcium sulphide present in the first ash product is converted to calcium carbonate"). **Further** note that Qiu et al. 2001 disclose the **specific** temperature 850°C (i.e., the lower limit recited in instant claim 6) **and** the **specific** temperature range 600-1000°C (i.e., which encompasses that recited in instant claim 6) (see p. 555, second full paragraph in col. 1, and end of paragraph bridging pp. 556-557).

10. Claim 8 is rejected under 35 U.S.C. § 103(a) as being unpatentable over the instant specification, pages 2 - 3, paragraphs [0005] - [0008], in view of Qiu et al. 2001, as applied to claim 1 above, and further in view of the Anthony, Jia, and Qiu article cited on the enclosed PTO-1449 (i.e., applicant's reference BG, hereinafter "Anthony et al."), and therefore—although no specific date has been provided—considered available as prior art against the instant claims (i.e.,

considered publicly available at least as early as June 22, 2003). The instant specification, pages 2 - 3, paragraphs [0005] - [0008], and Qiu et al. 2001 are relied upon as set forth above, considered to have rendered processes falling within the scope of instant claim 1 (upon which instant claim 8 depends) *prima facie* obvious. **However**, neither this admitted prior art portion of the specification nor Qiu et al. 2001 teaches that “a mixture of carbon dioxide and **nitrogen** is used to obtain the desired carbon dioxide partial pressure” (emphasis added), as recited in instant claim 8.

11. Like Qiu et al. 2001, Anthony et al. discuss CaS oxidation by reaction with CO₂, showing that “CO₂ can be an effective oxidant for CaS at temperatures above 600°C” (see abstract). Anthony et al. **further** teach that:

There are two **obvious** strategies to achieve CaS destruction with CO₂. The first is to operate at temperature above the stability of CaCO₃ with pure CO₂ (above 900°C) to ensure that the pores remain open, since our earlier work and this work both suggest that CaSO₄ formation is negligible with CO₂ oxidation. **The second is to operate at lower temperatures with mixtures of CO₂/N₂ such that CaCO₃ is not stable at the operating temperature of interest.** (last paragraph of “Results and Discussion” section, emphasis added)

Thus, when having combined the teachings of the instant specification, pages 2 - 3, paragraphs [0005] - [0008], with Qiu et al. 2001, as set forth in paragraphs 8.- 9. above, it would have been **further** obvious to one of ordinary skill, at the time of applicant’s invention, to have “operate[d] at lower temperatures with mixtures of CO₂/N₂ such that CaCO₃ is not stable at the operating temperature of interest”, **instead of** operating “at temperature above the stability of CaCO₃ with pure CO₂ (above 900°C)”, because, as just discussed, Anthony et al. **clearly** teach that

these two alternatives are equivalent, "obvious strategies to achieve CaS destruction with CO₂". When having done so, it is respectfully submitted that, absent evidence otherwise, processes falling within the scope of instant claim 8 would have obviously resulted.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. These references are considered cumulative to or less material than those discussed above. The brochure entitled "AFRC 2002 Spring Meeting" has been cited of interest, since it is considered to establish that Anthony, Jia, and Qiu presented a session entitled "CaS Oxidation by Reaction with CO₂" on May 9, 2002, in Ottawa, Canada.

13. Any inquiry concerning this communication should be directed to Ardith E. Hertzog at telephone number (571) 272-1347. The examiner can normally be reached on Monday through Friday (from about 8:30 a.m. - 4:30 p.m.).

14. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley S. Silverman, can be reached at (571) 272-1358. The fax phone number for the organization where this application is assigned is 703-872-9306.


15. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair->

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AEH
July 12, 2004



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